substrate over a buried oxide layer. Hence, reconsideration and allowance of the application are respectfully requested.

REMARKS

Claim 1 is amended as shown on the attached sheets to more clearly define the invention without narrowing the scope of the claimed invention. As discussed in detail below, the claimed invention distinguishes patentably over the cited references.

Rejection Under 35 U.S.C. 112

The Office Action rejects claim 2, which depends on claim 1, as being indefinite for reciting air as one choice for the fluid introduced in the chamber because the original claim 1 recites that the fluid is selected to be other than molecular oxygen. Claim 1 is now amended to recite that the fluid is selected to be other than *pure* molecular oxygen.

This amendment to claim 1 obviates the above 112 rejection of claim 2 because air includes other molecular species in addition to oxygen.

Rejections Under 35 U.S.C. 103

The Office Action rejects claims 1-13 as being obvious over the combined teachings of U.S. Patent No. 6,313,014 of Sakaguchi and U.S. Patent No. 5,468,657 of Hsu. More particularly, the Office Action states that although Sakaguchi does not teach implanting oxygen ions while a fluid other than oxygen is present in the chamber, Hsu describes introducing nitrogen ions into the chamber, and implanting ions into the substrate while nitrogen is present.

As discussed below, Hsu does not teach employing nitrogen as a *background gas* while implanting oxygen into the substrate, but rather, it describes *implanting* nitrogen and oxygen ions into the substrate, simultaneously or separately. Hence, neither Sakaguchi nor Hsu teaches or suggests employing a fluid as a background gas during ion implantation to inhibit formation of threading dislocations in a top silicon layer of a silicon substrate in which a buried oxide layer is formed through ion implantation.

The present invention relates generally to methods for SIMOX wafer processing of a silicon substrate that inhibit formations of threading dislocations in the top silicon layer. More particularly, claim 1, as amended, recites a method of processing a silicon substrate that includes evacuating a vacuum chamber in which the substrate is placed to a first pressure, introducing a fluid other than pure molecular oxygen into the vacuum chamber as a background gas, and implanting ions into the substrate to form a buried oxide layer under a top silicon layer. The fluid inhibits formations of threading dislocations in the top silicon layer.

As discussed in the response to the previous Office Action, Sakaguchi, which relates to a method of manufacturing an SOI substrate, fails to teach introducing a fluid into the implantation chamber during or before implanting ions into the substrate while the fluid is present in the chamber. In fact, Sakaguchi describes preparing a hydrogen-annealed single-crystal silicon substrate by heat-treating a silicon substrate in a reducing atmosphere containing hydrogen, and in a *separate step*, forming an ion-implantation layer in the hydrogen-annealed substrate by oxygen implantation. That is, in Sakaguchi, the silicon substrate is heat-treated in a reducing atmosphere before an ion implantation step whereas in the method of the invention, the fluid is present during the implantation step. Hence, Sakaguchi fails to teach or suggest the method of the invention.

Hsu is directed to a method for forming a buried insulating layer in a substrate, and more particularly, to a method of passivating an interface region between an insulating buried silicon oxide layer, formed in a silicon substrate via a SIMOX process, and the regions of the silicon substrate located above and/or below the buried insulating layer. For example, Hsu describes forming a buried oxide layer in a silicon substrate through the well-known steps of implanting oxygen ions in the substrate followed by an annealing step. Hsu further describes *implanting* nitrogen ions in the substrate to the depth of the insulating layer, and heating the substrate to cause migration of nitrogen ions to the interface regions extending between the insulating layer and the upper and lower regions of the substrate. The steps of nitrogen implantation can be performed before or after the implantation of oxygen ions, or substantially simultaneously with oxygen implantation. The passivation method of Hsu is primarily directed to causing nitrogen to form stable bonds with broken silicon and oxygen bonds in the interface regions without introducing nitrogen into the surface silicon layer. In fact, Hsu explains that one desirable

attribute of its method is that "it leaves upper monocrystalline silicon layer 42 free of implanted nitrogens." See col 9, lines 3-7.

In contrast, in the claimed method, a fluid, such as nitrogen, is utilized as a *background fluid* in the chamber to inhibit formation of threading dislocations in the top silicon layer. In other words, in the claimed method of the invention, the fluid is not implanted in the substrate but rather is employed as a background gas to inhibit formation of threading dislocation in the upper silicon layer. Hsu, however, does not employ nitrogen as a background gas, but rather, implants nitrogen in the substrate for a completely different purspose, namely, passivating interface regions between the oxide layer and the substrate.

Thus, the combined teachings of Sakaguchi and Hsu fail to teach the subject matter of claim 1. Hence, claim 1, and claims 2-11 depedendent on claim 1, are patentable.

Further, independent claim 12 recites a method of processing a substrate by placing it in a vacuum chamber that has been evacuated to a selected pressure and into which a fluid has been introduced. Subsequently, ions are implanted into the substrate to form a buried oxide layer under a top silicon layer. A decrease in the ion beam current level, due to the fluid in the chamber is measured, and the fluid level is adjusted based upon this measurement.

Sakaguchi does not teach or suggest introducing a fluid in a vacuum chamber before or during ion implantation of a substrate placed in the chamber. Consequently, there is no teaching or suggestion in Sakaguchi regarding measuring a decrease in the ion beam current due to the fluid introduced in the chamber, and adjusting the fluid level based on such a measurement. Further, Hsu does not teach utilizing a fluid as a background fluid in the vacuum chamber to inhibit formation of threading dislocations in the top silicon layer. Neither does Hsu teach or suggest measuring a change in the oxygen ion current density due to the presence of the nitrogen ions, and adjusting the nitrogen level based on such a measurement.

Hence, claim 12, and claim 13 dependent thereon, distinguish patentably over the combined teachings of the references.

CONCLUSION

In view of the above amendments and remarks, Applicants respectfully request reconsideration and allowance of the application. If there are any remaining issues, Applicants invite the examiner to call the undersigned at (617-439-2514).

Dated: February 24, 2003

Respectfully submitted,

By [signature]

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Version With Markings to Show Changes Made

1. (Amended) A method of processing a silicon substrate, comprising:

evacuating a vacuum chamber in which the substrate is placed to a first pressure,

introducing a fluid other than pure molecular oxygen into the vacuum chamber as a background fluid, and

implanting ions into the substrate to form a buried oxide layer under a top silicon layer, wherein the fluid inhibits formations of threading dislocations in the top silicon layer for reducing a defect density of the processed substrate.